Attorney Docket No. 13DV-13906 (07783-0081) Serial No. 10/029,365

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of HARRISON et al.

:

Serial No.

10/029,365

Group Art Unit 1742

Application Filed

December 20, 2001

Examiner: Sheehan, John P.

For: METHOD OF RESTORATION OF MECHANICAL PROPERTIES OF A CAST NICKEL-BASED SUPERALLOY FOR SERVICED AIRCRAFT COMPONENTS

DECLARATION UNDER 37 CFR § 1.132

Thomas J. Kelly, hereby certifies the following:

- 1. I am a joint inventor of all the claims of the patent application identified above and I am a joint inventor of the subject matter described and claimed therein.
- I have extensive knowledge of the compositions of superalloy materials and I am
 familiar with trademarks of superalloy materials, as I am skilled in the art of superalloy
 compositions.
- 3. To the best of my knowledge, the trademark "Inconel 903" for a superalloy material does not exist in the art. The use of such a designation would be recognized by one skilled in the art as referring to the trademark "INCOLOY® 903," which does exist.
- 4. To the best of my knowledge, the trademark "Inconel 907" for a superalloy material does not exist in the art. The use of such a designation would be recognized by one skilled in the art as referring to the trademark "INCOLOY® 907," which does exist.
- 5. To the best of my knowledge, the trademark "Inconel 909" for a superalloy material does not exist in the art. The use of such a designation would be recognized by one skilled in the art as referring to the trademark "INCOLOY® 909," which does exist.
- 6. The term INCOLOY® generally is used with reference to an alloy falling in the family of iron-base superalloys.
- 7. The term INCONEL® generally is used with reference to an alloy falling in the family of nickel-base superalloys.

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- 8. I have observed incorrect usages of the terms INCOLOY® and INCONEL®. Examples of such incorrect usages are available on the Internet.
- 9. I hereby acknowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of this application or any patent issuing thereon, and I hereby declare that all statements made in this declaration of my own knowledge are true and that all statements made on information and belief are believed to be true.

Thomas J. Kelly

Thomas J. Kelly

Nominal compositions and densities of selected cast nickel-base superalloys (continued)

٠.	L					Co	mp siti	on, %							
Alloy	С	Cr	Co	Мо	W	Ta	Nb	Al	Ti	Hf	Zr	В	Ni	Other	Density, g/cm ³
Waspaloy	0.06	19.0	12.3	3.8	_	_		1.2.	3.0	_	0.01	0.005	bal	0.45 Mn	_
NX 188	0.04	<u> </u>	_	18.0	_ [_	l —	8.0		. —		_	bal	0.101.	_
SEL	0.08	15.0	26.0	4.5			l —	4.4	2.4		·	0.015	bal	_	_
CMSX-2(a)	-	8.0	4.6	0:6	8.0	6.0	·	5.6	1.0		— '	_	bal	_	8.6
GMR-235	0.15	15.0	—	4.8	_	- .	\ <u>\</u>	3.8	2.0		_	0.05	bal	0.3 Mn, 0.4	. 8.0
<u> </u>														Si, 11.0 Fe	_
CMSX-3(a)	—	8.0	4.6	0.6	8.0	6.0	—	5.6	1.0	0.10	_		bal	_	8.6
CMSX-4(a)	-	6.4	9.6	0.6	6.4	6.5	l —	5.6	1.0	0.10	_	_	bal	3.0 Re	8. <i>7</i>
CMSX-6(a)	l —	. 9.9	5.0	3.0	<u> </u>	2.0		4.8	4.7	0.05			bal		7.98
GMR-235	0.15	15.0	-	4.8		_	_	3.5	2.5			0.05	bal	4.5 Fe	8.04
SEL-15	0.07	11.0	14.5	6.5	1.5	_	0.5	5.4	2.5			0.015	bal		8.7
UDM 56	0.02	16.0	5.0	1.5	6.0		_	4.5	2.0		0.03	0.070	bal	0.5 V	8.2
M-22	0.13	5. <i>7</i>		2.0	11.0	3.0	_	6.3	_	_	0.60	_	bal		8.63
IN-731	0.18	9.5	10.0	2.5	· —	_	:	5.5	4.6		0.06	0.015	bal	1.0 V	7.75
MAR-M 421	0.14	15.8	9.5	2.0	3.8	— .		4.3	1.8	_	0.05	0.015	bal		8.08
MAR-M 432	0.15	15.5	20.0		3.0	2.0	2.0	2.8	4.3		0.05	0.015	bal	·	8.16
MC-102	0.04	20.0		6.0	2.5 -	. 0.6	6.0	<u> </u>		_	—	_	bal	0.25 Si.	
	1.				٠.									0.30 Mn	
Nimocast 242	0.34	20.5	10.0	10.5	_	_	· —	0.2	0.3	_	_		bal	1.0 Fe, 0.3	8.40
Nimo and 967	اممدا	20.0	200	-										Mn, 0.3 Si	
Nimocast 263	0.06	20.0	20.0	5.8	-	_	-	0.5	2.2		0.04	0.008	bal	0.5 Fe,	8.36
	<u> </u>													0.5 Mn	

(a) Single crystal

Physical properties of cast nickel-base and cobalt-base alloys

						Specif	ic heat				The	rmal co	onduc	tivity	-		Mear	
			elting nge		21°C)°F)		38°C 00°F)		093°C		93°C 0°F)		38°C 10°F)		93°C 90°F)	ther	mear fficien mal ex on, 10°	t of pan-
Alloy	Density, g/cm³	ာ့	ор	J/kg·K	Btu/lb · °F	J/kg·K	Btu/lb · ºF	J/kg·K	Btu/lb · °F	W/m·K	Btu · in/h · ft² · °F	W/m⋅K	Btu · in /h · ft² · °P	W/m·K	Btu·in/h·ft²·°F	At 93°C (200°F)	At 538°C (1000°F)	At 1093°C (2000°F)
Nickel base									·	·	L			<u> </u>	<u> </u>	· · ·	· · ·	13.3
IN-713 C	7.91	1260- 1290	2300- 2350	420	0.10	565	0.135	710	0.17	10.9	76	17.0	118	26.4	183	10.6	13.5	17.1
IN-713 LC	8.00	1290- 1290- 1320	2350- 2350- 2410	440	0.105	565	0.135	710	0.17	10.7	74	16.7	116	25.3	176	10.1	15.8	18.9
B-1900	8.22	1275- 1300	2325- 2375	_	_	_	_			(10.2)	(71)	16.3	113	_	<u> </u>	11.7	13.3	16.2
Cast alloy 625 Cast alloy 718	8.44 8.22	 1205-	 2200-	<u>-</u>	_	_	_	_	_	_		_	_		_	_		_
IN-100	7.75	1345 126 13	2450	,	ii			,	L	[l		<u> </u>	<u> </u>	13.0	13.9	18.1
IN-162	8.08	12 13			* 1 3									<u>-</u>	_	12.2	14.1	_
IN-731 IN-738	7.75 8.11	123 13:			;				•					.2	 189	11.6	 14.0	_
IN-792 M-22 MAR-M 200	8.25 8.63 8.53	131			,	*									-	12.4	13.3	
MAR-M 246	8.44	1370 1315-	2400-	_	. <u>::</u>	=			_		_	18.9	131	.7 30.0	206 208	11.3	13.1 14.8	17.0 18.6
MAR-M 247 MAR-M 421	8.53 8.08	1345	2450 —	_	<u> </u>		(4), (1) (<u>1</u> 2)	_		_	_	19.1	 137	 32.0	<u> </u>		14.9	 19.8

Continue

SUPERALLOYS

Nominal compositions of wrought iron-base superalloys (continued)

	Composition, %														
Alloy	Ni	Cr	Co	Mo	W	Nb	Al	Ti	Fe	Mn	Si	С	В	Other	
Incoloy 909	38.0	· —	13.0	_	_	4.7		1.5	42.0	-	0.4	0.01	0.001		
N-155	20.0	21.0	20.0	3.0	2.5	1.0		—	30.0	1.5	0.5	0.15	_	0.15 N	
V-57	27.0	14.8		1.3		<u> </u>	0.3	3.0	52.0	0.3	0.7	0.08	0.010		
19-9 DL	9.0	19.0	0.4	_	1.3	_	—	0.3	bal	1.0	0.50	0.3	_	***	
16-25-6	25.5	16.25	_	6.0	_	ļ	<u> </u>		bal	2.0	1.0	0.10		_	
Pyromet CTX-1	37.7	0.1	16.0	0.1	l —	3.0	1.0	1.7	39.0		_	0.03	_	_	
Pyromet CTX-3	38.3	0.2	13.6			4.9	0.1	1.6	bal		0.15	0.05	0.007		
17-14CuMo	14.0	16.0		2.5	l —	0.4	 	0.3	62.4	0.75	0.50	0.12	_	3.0 Cu	
20-Съ3	34.0	20.0	 	2.5	-	1.0	—	l —	42.4	_	_	0.07	l <u> </u>	3.5 Cu	

Nominal compositions and densities of selected cast nickel-base superalloys

IN-718 René 200 IN-625 IN-713C IN-713LC IN-713LC IN-713 Hf (MM 004) IN-100 IN-738LC IN-738LC IN-738LC IN-738LC IN-738LC IN-738LC IN-792 IN-939 IN-939 IN-900 IN-900 IN-900 IN-900 IN-900 IN-910 IN-900 IN-900 IN-900 IN-900 IN-900 IN-910 IN-900	0.04 1: 0.03 1: 0.06 2: 0.05 1	Cr Co 18.5 — 19.0 12.0 11.5 — 12.5 — 12.0 — 12.0 — 10.0 15.0 16.0 8.5 12.7 9.0 12.4 19.0 18.0 10.0 19.0 10.0 19.0 10.0 19.0 10.0 19.0 10.0 19.0 10.0 19.0 10.0	8.5 4.2 4.5 4.5 1.75 1.75 2.0 6.0 6.0 3.0	W — — — — — — — — — — — — — — — — — — —	Ta	Nb 5.1 5.1 4.0 2.0 2.0 2.0 0.9 0.9 1.0 1.8 1.0	A1 0.5 0.5 0.2 6.1 5.9 5.5 3.4 3.2 1.9 6.0 6.0 6.0 5.5 5.0	Ti 0.9 1.0 0.2 0.8 0.6 0.6 4.7 3.4 4.2 3.7 1.0 1.0 1.5 2.0	Hf	Zr — — — — — — — — — — — — — — — — — — —	B	Ni bal	Other 18.5 Fe 2.5 Fe 1.0 V	8.22
Remé 200 0.0 IN-625 0.0 IN-625 0.0 IN-713C 0.0 IN-713LC 0.0 IN-713Hf 0.0 IN-713Hf 0.0 IN-738C 0.1 IN-738C 0.1 IN-738LC 0.0 IN-738LC 0.0 IN-738LC 0.0 IN-738LC 0.0 IN-738LC 0.0 IN-792 0.0 IN-939 0.0 I	0.03 1: 0.06 2: 0.12 1: 0.05 1: 0.05 1: 0.07 1: 0.11 1: 0.11 1: 0.12 1: 0.15 2: 0.10 8: 0.10 8: 0.10 9: 0.14 9: 0.15 9: 0.15 9: 0.16 9: 0.17 9: 0.18 9: 0.19 9: 0.19 9: 0.19 9: 0.19 9: 0.19 9: 0.19 9: 0.19 9: 0.19 9: 0.19 9: 0.11 9: 0.15 9: 0.16 9: 0.17 9: 0.18 9: 0.19 9: 0.19 9: 0.19 9: 0.19 9: 0.19 9: 0.11 9: 0.11 9: 0.12 9: 0.15 9: 0.16 9: 0.17 9: 0.18 9: 0.19 9: 0.19 9: 0.19 9: 0.10 9: 0.11 9: 0.12 9: 0.15 9: 0.16 9: 0.17 9: 0.18 9: 0.19 0. 0.19 9: 0.19 0. 0.19 9: 0.10 9: 0.1	19.0 12.0 12.15 12.5 12.5 12.0 12.0 12.0 12.0 12.0 12.0 12.0 13.0	3.2 8.5 4.2 4.5 4.5 1.75 1.75 2.0 6.0 6.0 3.0		1.75 1.75 1.75 3.9 1.4 4.3 4.3	5.1 4.0 2.0 2.0 2.0 0.9 0.9 1.0	0.5 0.2 6.1 5.9 5.5 3.4 3.2 1.9 6.0 6.0 5.5 5.0	1.0 0.2 0.8 0.6 0.6 4.7 3.4 4.2 3.7 1.0 1.0	1.3	0.10 0.06 0.10 0.04 0.10 0.10 0.08 0.08	0.012 0.01 0.01 0.01 0.01 0.01 0.02 0.009 0.015 0.015	bal	2.5 Fe — — —	8.25 8.00
IN-625 IN-713C IN-713LC IN-713LC IN-713LC IN-713Hf (MM 004) IN-100 IN-100 IN-738C IN-738LC IN-738LC IN-738LC IN-792 IN-939 B-1900 B-1900 Hf (MM 007) B-1910 MM 002 MAR-M 200 MAR-M 200 Hf (MM 009) MAR-M 246 Hf (MM 009) MAR-M 246 Hf (MM 009) MAR-M 246 Hf (MM 001) CM 247LC René 41 CM 247LC René 41 CM 247LC René 80 René 80 René 80 René 80 René 80 René 80 René 125 Hf O.0	0.06 2 12 12 12 13 14 15 15 15 15 15 15 15	21.5 — 12.5 — 12.0 — 12.0 — 15.0 16.0 8.5 8.5 12.7 9.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0	8.5 4.2 4.5 4.5 1.75 1.75 2.0 6.0 6.0 3.0		1.75 1.75 1.75 3.9 1.4 4.3 4.3	4.0 2.0 2.0 2.0 2.0 0.9 0.9 1.0 —	02 6.1 5.9 5.9 5.5 3.4 3.2 1.9 6.0 6.0 5.5 5.0	0.2 0.8 0.6 0.6 4.7 3.4 3.4 4.2 3.7 1.0 1.0	1.3	0.10 0.06 0.10 0.04 0.10 0.10 0.08 0.08	0.01 0.014 0.01 0.01 0.01 0.02 0.009 0.015 0.015	bal bal bal bal bal bal bal bal bal bal	= .	8.00 7.75 8.11 — 8.25 8.2 8.2 8.25 —
IN-713C 0.1 IN-713LC 0.6 IN-713LC 0.6 IN-713 Hf (MM 004) 0.1 IN-100 0.1 IN-738C 0.1 IN-738LC 0.1 IN-738LC 0.1 IN-792 0.2 IN-939 0.3 B-1900 0.1 B-1900 0.1 B-1900 0.1 IN-792 0.2 IN-939 0.3 IN-939	0.12 1: 0.05 1: 0.05 1: 0.18 1: 0.17 1: 0.17 1: 0.11 1: 0.15 2: 0.10 8: 0.10 1: 9 0.15 9: 0.15 9: 0	12.5 — 12.0 — 12.0 — 15.0 16.0 8.5 16.0 8.5 12.7 9.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0	4.2 4.5 4.5 3.0 1.75 2.0 6.0 6.0 3.0 —	2.6 2.6 3.9 2.0 — — — — 12.5 12.5	1.75 1.75 3.9 1.4 4.3 4.3	2.0 2.0 2.0 0.9 0.9 1.0 —	6.1 5.9 5.9 5.5 3.4 3.2 1.9 6.0 6.0 5.5 5.0	0.8 0.6 0.6 4.7 3.4 3.4 4.2 3.7 1.0 1.0	1.3	0.10 0.06 0.10 0.04 0.10 0.10 0.08 0.08	0.01 0.014 0.01 0.01 0.01 0.02 0.009 0.015 0.015	bal bal bal bal bal bal bal bal bal	= .	8.00 7.75 8.11 — 8.25 8.2 8.2 8.25 —
IN-713LC 0.0 IN-713 Hf (MM 004) IN-100 0.1 IN-738C 0.1 IN-738LC 0.1 IN-738LC 0.1 IN-738LC 0.1 IN-792 0.2 IN-939 0.3 B-1900 Hf (MM 007) 0.1 B-1910 0.1 MM 002 0.1 MAR-M 200 0.1 MAR-M 200 0.1 MAR-M 200 0.1 Hf (MM 009) MAR-M 246 0.1 Hf (MM 0011) 0.1 CM 247LC 0.0 René 41 0.0 René 80 0.1 René 80 0.1 René 80 0.1 René 100 0.1 René 100 0.1 René 125 Hf 0.1	0.05 12 0.05 12 0.18 14 0.17 16 0.17 16 0.19 12 0.15 22 0.10 8 0.10 8 0.10 9 0.15 9	12.0 — 12.0 15.0 16.0 8.5 16.0 8.5 12.7 9.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0	4.5 4.5 3.0 1.75 1.75 2.0 6.0 6.0 3.0	2.6 2.6 3.9 2.0 — — — — 12.5 12.5	1.75 1.75 3.9 1.4 4.3 4.3	20 20 	5.9 5.9 5.5 3.4 3.2 1.9 6.0 6.0 6.0 5.5 5.0	0.6 0.6 4.7 3.4 3.4 4.2 3.7 1.0 1.0	1.3 	0.10 0.06 0.10 0.04 0.10 0.10 0.08 0.08	0.01 0.014 0.01 0.01 0.01 0.02 0.009 0.015 0.015	bal bal bal bal bal bal bal bal	1.0 V	8.00 7.75 8.11 — 8.25 8.2 8.2 8.25 —
IN-713 Hf (MM 004) IN-100 IN-738C IN-738C IN-738C IN-738L IN-792 IN-939 B-1900 B-1900 Hf (MM 007) B-1910 MM 002 MAR-M 200 MAR-M 200 Hf (MM 009) MAR-M 246 Hf (MM 009) MAR-M 246 Hf (MM 006) MAR-M 246 Hf (MM 0011) CM 247LC René 41 René 77 René 80 René 80 René 80 René 80 René 80 René 105 René 100 René 125 Hf IN-738L IN-738C IN-7	0.05 1: 0.18 10 0.17 10 0.11 10 0.11 10 0.21 1: 0.15 2: 0.10 8 0.10 10 0.15 9 0.15 9	12.0 — 15.0 16.0 8.5 16.0 8.5 16.0 8.5 12.7 9.0 12.4 19.0 8.0 10.0 10.0 10.0 9.0 10.0 9.0 10.0 9.0 10.0	4.5 3.0 1.75 1.75 2.0 6.0 6.0 3.0 2.5	2.6 2.6 3.9 2.0 — — — — 12.5 12.5	1.75 1.75 3.9 1.4 4.3 4.3	2.0 — 0.9 0.9 — 1.0 — — — — — 1.8	5.9 5.5 3.4 3.2 1.9 6.0 6.0 5.5 5.0	0.6 4.7 3.4 3.4 4.2 3.7 1.0 1.0		0.10 0.06 0.10 0.04 0.10 0.10 0.08 0.08 0.10 0.05	0.014 0.014 0.01 0.01 0.002 0.009 0.015 0.015	bal bal bal bal bal bal bal bal bal	1.0 V	7.75 8.11 — 8.25 8.2 8.2 8.25
(MM 004) IN-100 IN-738C IN-738LC IN-738LC IN-792 IN-939 B-1900 B-1900 Hf (MM 007) B-1910 MM 002 MAR-M 200 Hf (MM 009) MAR-M 246 Hf (MM 006) MAR-M 246 Hf (MM 001) CM 247LC IN-247LC IN-	0.18 10 0.17 16 0.11 16 0.21 17 0.15 22 0.10 8 0.10 8 0.10 10 0.15 9 0.15 9 0.15 9 0.15 9 0.15 9 0.15 9 0.15 9 0.15 9 0.15 9	10.0 15.0 15.0 16.0 8.5 16.0 8.5 12.7 9.0 10.0	3.0 1.75 1.75 2.0 6.0 6.0 3.0	26 26 3.9 2.0 — — 12.5 12.5	1.75 3.9 1.4 4.3 4.3	1.0 	5.5 3.4 3.4 3.2 1.9 6.0 6.0 5.5 5.0	4.7 3.4 3.4 4.2 3.7 1.0 1.0		0.06 0.10 0.04 0.10 0.10 0.08 0.08	0.014 0.01 0.01 0.02 0.009 0.015 0.015	bal bal bal bal bal bal bal	1.0 V	8.11
IN-100 IN-738C IN-738C IN-738LC IN-738LC IN-792 IN-939 B-1900 B-1900 Hf (MM 007) B-1910 MM 002 MAR-M 200 Hf (MM 009) MAR-M 246 Hf (MM 006) MAR-M 246 Hf (MM 006) MAR-M 247 (MM 0011) CM 247LC René 41 René 77 René 80 René 80 René 80 René 80 René 80 René 105	0.17 10 0.11 10 0.21 12 0.15 22 0.10 8 0.10 8 0.10 10 0.15 9 0.15 9 0.15 9 0.15 9 0.15 9 0.15 9 0.15 9 0.15 9	16.0 8.5 16.0 8.5 12.7 9.0 12.4 19.0 8.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 9.0 10.0 9.0 10.0	1.75 1.75 2.0 6.0 6.0 3.0 —	2.6 3.9 2.0 — — 12.5 12.5	1.75 3.9 1.4 4.3 4.3	0.9 0.9 	3.4 3.4 3.2 1.9 6.0 6.0 5.5 5.0	3.4 3.4 4.2 3.7 1.0 1.0		0.10 0.04 0.10 0.10 0.08 0.08	0.01 0.02 0.009 0.015 0.015 0.015	bal bal bal bal bal bal bal	1.0 V	8.11
IN-738C 0.1 IN-738LC 0.1 IN-738LC 0.1 IN-792 0.2 IN-939 0.3 B-1900 Hf () () IN-910 0.3 IN-710 0.3 IN-910	0.17 10 0.11 10 0.21 12 0.15 22 0.10 8 0.10 8 0.10 10 0.15 9 0.15 9 0.15 9 0.15 9 0.15 9 0.15 9 0.15 9 0.15 9	16.0 8.5 16.0 8.5 12.7 9.0 12.4 19.0 8.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 9.0 10.0 9.0 10.0	1.75 1.75 2.0 6.0 6.0 3.0 —	2.6 3.9 2.0 — — 12.5 12.5	1.75 3.9 1.4 4.3 4.3	0.9 0.9 	3.4 3.4 3.2 1.9 6.0 6.0 5.5 5.0	3.4 3.4 4.2 3.7 1.0 1.0		0.10 0.04 0.10 0.10 0.08 0.08	0.01 0.02 0.009 0.015 0.015 0.015	bal bal bal bal bal bal bal	1.0 V	8.11
IN-738LC 0.1 IN-792 0.2 IN-939 0.3 B-1900 Hf 0.3 IN-910 0.3 B-1910 0.3 MM 002 0.3 MAR-M 200 0.3 MAR-M 200 0.3 MAR-M 246 0.3 MAR-M 246 0.3 MAR-M 247 (MM 0011) CM 247LC 0.0 René 41 0.0 René 80 Hf René 100 0.3 René 80 Hf René 100 0.3 René 125 Hf 0.3	0.11 10.21 12.0.15 22.0.10 8 8 0.10 10.15 9 9 0.15 9 9 0.14 9 9 0.15 9 0.15 9 9 0.15 9 0.15 9 9 0.15 9 0.15 9 9 0.15 9 0.15 9 9 0.15 9 0.15 9 0.15 9 0.15 9 0.15 9 0.15 9 0.15 9 0.15 9 0.15 9 9 0.15 9 0	16.0 8.5 12.7 9.0 12.4 19.0 8.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 9.0 10.0 9.0 10.0	1.75 2.0 6.0 6.0 3.0 —	2.6 3.9 2.0 — — 12.5 12.5	1.75 3.9 1.4 4.3 4.3	0.9 1.0 1.8	3.4 3.2 1.9 6.0 6.0 5.5 5.0	3.4 4.2 3.7 1.0 1.0		0.04 0.10 0.10 0.08 0.08 0.10 0.05	0.01 0.02 0.009 0.015 0.015	bal bal bal bal bal bal bal		8.25 8.2 8.2 8.2 8.25
IN-792 0.2 IN-939 0.3 B-1900 Hf (MM 007) B-1910 0.1 MM 002 0.1 MAR-M 200 MAR-M 200 MAR-M 246 MAR-M 246 MAR-M 247 (MM 0011) CM 247LC René 41 0.0 René 80 Hf René 100 René 125 Hf 0.1 René 100 René	0.21 12 0.15 22 0.10 8 0.10 8 0.10 10 0.15 9 0.15 9 0.15 9 0.15 9 0.15 9	12.7 9.0 12.4 19.0 8.0 10.0 8.0 10.0 10.0 10.0 9.0 10.0 9.0 10.0 9.0 10.0 9.0 10.0	2.0 6.0 6.0 3.0 —	3.9 2.0 — — — — 12.5 12.5	3.9 1.4 4.3 4.3 7.0	1.0 1.8	3.2 1.9 6.0 6.0 5.5 5.0	4.2 3.7 1.0 1.0 1.0	- 1.5	0.10 0.10 0.08 0.08 0.10 0.05	0.02 0.009 0.015 0.015 0.015	bal bal bal bal bal bal	-	8.2 8.2 8.25 —
IN-939 0.3 B-1900 Hf (MM 007) B-1910 0.3 MM 002 0.3 MAR-M 200 MAR-M 200 Hf (MM 009) MAR-M 246 Hf (MM 006) MAR-M 247 (MM 0011) CM 247LC René 41 0.6 René 80 Hf René 100 0.1 René 100 0.1 René 125 Hf 0.0	0.15 20 0.10 8 0.10 10 0.15 9 0.15 9 0.15 9 0.15 9 0.15 9	22.4 19.0 8.0 10.0 8.0 10.0 10.0 10.0 9.0 10.0 9.0 10.0 9.0 10.0 9.0 10.0	6.0 6.0 3.0 — —	2.0 12.5 12.5	1.4 4.3 4.3 7.0	1.0 — — — 1.8	1.9 6.0 6.0 5.5 5.0	3.7 1.0 1.0 1.0	- 1.5	0.10 0.08 0.08 0.10 0.05	0.009 0.015 0.015 0.015 0.015	bal bal bal bal bal		8.2 8.2 8.25 —
B-1900 0.1 B-1900 Hf (MM 007) B-1910 0.1 MM 002 0.1 MAR-M 200 0.1 MAR-M 200 0.1 Hf (MM 009) MAR-M 246 0.1 Hf (MM 006) MAR-M 247 (MM 0011) CM 247LC 0.0 René 41 0.0 René 80 0.1 René 80 0.1 René 100 0.1 René 125 Hf 0.1	0.10 8 0.10 10 0.15 9 0.15 9 0.14 9 0.15 9	8.0 10.0 8.0 10.0 10.0 10.0 9.0 10.0 9.0 10.0 9.0 10.0 9.0 10.0	6.0 6.0 3.0 — — — 2.5		4.3 4.3 7.0		6.0 6.0 6.0 5.5 5.0	1.0 1.0 1.0 1.5	 1.5 	0.08 0.08 0.10 0.05	0.015 0.015 0.015 0.015	bal bal bal bal		8.2 8.25 —
B-1900 Hf (MM 007) B-1910 0.1 MM 002 0.2 MAR-M 200 0.1 Hf (MM 009) MAR-M 246 Hf (MM 006) MAR-M 247 (MM 0011) CM 247LC René 41 René 77 René 80 René 80 René 80 Hf René 100 René 125 Hf 0.0	0.10 8 0.10 10 0.15 9 0.15 9 0.14 9 0.15 9	8.0 10.0 10.0 10.0 9.0 10.0 9.0 10.0 9.0 10.0 9.0 10.0	6.0 3.0 — — — 2.5	- 12.5 12.5	4.3 7.0		6.0 6.0 5.5 5.0	1.0 1.0 1.5	_	0.08 0.10 0.05	0.015 0.015 0.015	bal bal bal		8.25
(MM 007) B-1910 0.1 MM 002 0.1 MAR-M 200 0.1 MAR-M 200 Hf (MM 009) MAR-M 246 MAR-M 246 Hf (MM 006) MAR-M 247 (MM 0011) CM 247LC 0.0 René 41 0.1 René 77 René 80 René 80 René 80 Hf René 100 René 125 Hf 0.1	0.10 10 0.15 9 0.15 9 0.14 9 0.15 9 0.15 9	10.0 9.0 10.0 9.0 10.0 9.0 10.0 9.0	3.0	12.5 12.5	7.0		6.0 5.5 5.0	1.0 1.5	_	0.10 0.05	0.015 0.015	bal bal		<u> </u>
B-1910 0.1 MM 002 0.1 MAR-M 200 0.1 MAR-M 200 0.1 Hf (MM 009) MAR-M 246 0.1 Hf (MM 006) MAR-M 247 (MM 0011) CM 247LC 0.0 René 41 0.0 René 80 René 80 René 80 Hf René 100 0.1 René 125 Hf 0.1	0.15 9 0.15 9 0.14 9 0.15 9 0.15 9	9.0 10.0 9.0 10.0 9.0 10.0 9.0 10.0	2.5	12.5			5.5 5.0	1.5	 1.5	0.05	0.015	bal		
MM 002 MAR-M 200 MAR-M 200 Hf (MM 009) MAR-M 246 MAR-M 246 Hf (MM 006) MAR-M 247 (MM 0011) CM 247LC René 41 René 77 René 80 René 80 René 80 Hf René 100 René 125 Hf 0.1	0.15 9 0.15 9 0.14 9 0.15 9 0.15 9	9.0 10.0 9.0 10.0 9.0 10.0 9.0 10.0	2.5	12.5			5.5 5.0	1.5	 1.5	0.05	0.015	bal	_	
MAR-M 200 MAR-M 200 Hf (MM 009) MAR-M 246 MAR-M 246 Hf (MM 006) MAR-M 247 (MM 0011) CM 247LC 0.0 René 41 0.0 René 80 René 80 René 80 René 80 René 125 Hf 0.1	0.15 9 0.14 9 0.15 9 0.15 9	9.0 10.0 9.0 10.0 9.0 10.0	2.5	12.5	2.5 — —		5.0		1.5				_	-
MAR-M 200 Hf (MM 009) MAR-M 246 MAR-M 246 Hf (MM 006) MAR-M 247 (MM 0011) CM 247LC 0.0 René 41 0.0 René 80 René 80 René 80 René 80 René 80 René 125 Hf 0.1	0.14 9 0.15 9 0.15 9	9.0 10.0 9.0 10.0	2.5	12.5	_			2.0		0.00	A 04F	bal	1	0.50
Hf (MM 009) MAR-M 246 MAR-M 246 Hf (MM 006) MAR-M 247 (MM 0011) CM 247LC René 41 0.0 René 80 René 80 René 80 René 80 René 100 René 125 Hf 0.1	0.15 9 0.15 9	9.0 10.0	2.5			1.0				0.05	0.015	ı vaı	1 —	8.53
MAR-M 246 MAR-M 246 Hf (MM 006) MAR-M 247 (MM 0011) CM 247LC René 41 René 77 René 80 René 80 René 80 Hf René 100 René 125 Hf 0.1	0.15 9			40.0			5.0	2.0	2.0	_	0.015	bal	·	
MAR-M 246 Hf (MM 006) MAR-M 247 (MM 0011) CM 247LC René 41 0.0 René 77 René 80 0.1 René 80 Hf René 100 0.1 René 125 Hf 0.1	0.15 9			1	1									
Hf (MM 006) MAR-M 247 (MM 0011) CM 247LC René 41 0.0 René 77 René 80 0.1 René 80 Hf René 100 0.1 René 125 Hf 0.1		9.0 10.0		10.0	1.5		5.5	1.5		0.05	0.015	bal	_	8.44
MAR-M 247 (MM 0011) CM 247LC 0.0 René 41 0.0 René 77 0.0 René 80 0.1 René 80 Hf 0.1 René 100 0.1 René 125 Hf 0.1	0.16 8		2.5	10.0	1.5		5.5	1.5	1.4	0.05	0.015	bal	l —	_
(MM 0011) CM 247LC 0.0 René 41 0.0 René 77 0.0 René 80 0.1 René 80 Hf 0.1 René 100 0.1 René 125 Hf 0.1	0.16 8	. 1			i									
CM 247LC 0.0 René 41 0.0 René 77 0.0 René 80 0.1 René 80 Hf 0.1 René 100 0.1 René 125 Hf 0.1		8.5 10.0	0.65	10.0	3.0	·—	5.6	1.0	1.4	0.04	0.015	bal		8.53
René 41 0.0 René 77 0.0 René 80 0.1 René 80 Hf 0.1 René 100 0.1 René 125 Hf 0.1			1	1		,								3.25
René 77 0.0 René 80 0.1 René 80 Hf 0.1 René 100 0.1 René 125 Hf 0.1	0.07 8	8.1 9.3	0.5	9.5	3.0		5.6	0.7	1.4	0.01	0.015	bal		l
René 80 0.1 René 80 Hf 0.1 René 100 0.1 René 125 Hf 0.1	0.08 19	9.0 10.5	9.5		· —		1.7	3.2		0.01	0.005	bal	_	
René 80 Hf 0.1 René 100 0.1 René 125 Hf 0.1	0.08 15	5.0 18.5	5.2	l —			4.25	3.5	·		0.015	bal		7.91
René 100 0.1 René 125 Hf 0.1	0.17 14	4.0 9.5	4.0	4.0	- 1		3.0	5.0		0.03	0.015	bal	_	8.16
René 125 Hf 0.1	0.15 14	4.0 9.5	4.0	4.0	·		3.0	4.7	0.8	0.01	0.015	bal	_	-
	0.15 9	9.5 15.0	3.0	<u>-</u>		_	5.5	4.2		0.06	0.015	bal	1.0 V	7.75
(MM 005)	0.10 9	9.0 10.0	2.0	7.0	3.8		4.8	2.6	1.6	0.05	0.015	bal	1	
										-1.00	5,020	-	•	
Nimocast 75 0.1	0.12 20	0.0	1 —	_	_	_	_	0.5	_	_	_ 1	bal		8.44
Nimocast 80 0.0	0.05 19	9.5 —					1.4	2.3	_		_ 1	bal	1.5 Fe	8.17
	0.06 19	9.5 18.0		ľ — I	_	·	1.4	2.4				bal	1.5 Fe	8.18
Nimocast 95 0.0	0.07 19	9.5 18.0	_				2.0	2.9		0.02	0.015	bal	1.510	0.10
Nimocast 100 0.2).20 11	1.0 20.0	5.0				5.0	1.5		0.03	0.015	bal		
Udimet 500 0.0	0.08 18	8.5 16.5	3.5	_			3.0	3.0		<u> </u>	0.006	bal		8.02
Udimet 700 0.0	0.08 14	43 14.5	4.3	1 _ 1			4.25	3.5		0.02	0.015	bal		0.02
		8.0 15.0	3.0	1.5	_		2.5	5.0	. —	0.08	0.010	bal		8.08
		1.5	10.0			·	0.8	2.6		_	_	bal		0.00
		0.0 10.0	10.3		_		0.1	0.2	_			bai		
		0.0 20.0	5.9	<u> </u>			0.45	2.15		0.02	0.001	bal		
, ,		5.5 10.0	8.0		_		4.2	3.6	_	<u> </u>	0.001	bal		
Hastelloy X 0.0		1.8 1.5	9.0	0.6		[_	5.5		_	0.000	bal .	18.5 Fe, 0.5	
10.0	LUS I 21			5.5	.	:	[_ [_		_	שנו	Mn. 0.3 Si	_
Hastelloy S 0.0	.08 21	1	, ,	<u></u>	_		0.40		/	1	0.009	bal -	1 7	
0.0		6.0 —	15.0		1	I	U. AU				0.003	DQI .	3.0 Fe, 0.02,	
• 1		6.0 —	15.0	_	i	J							La, 0.65 Si,	

Chemical compositions of some nickel-base P/M superalloys (continued)

							Cor	npositio					
Alloy	С	Ni	Cr	Co	Mo	W	Ta	Nb	Hf	Al	Ti	v	B Zr
New alloys												: , '	
RSR 103 RSR 104 RSR 143		bal bal bal	=	_	15.0 18.0 14.0	-	6.0	<u>-</u>		8.4 8.0 6.0	-	11.	
RSR 185	0:04	bal		<u> </u>	14.4	6.1	<u> </u>	<u> </u>	.—	6.8		_	_ `

Nominal compositions of selected cast cobalt-base superalloys

						Cor	npositio	n, %			•	٠.	· ·	Density,
Alloy	· C	Cr	Ni	W	Ta	Nb	Mo	Ti	В	Zr	Fe	Co	Other	g/cm ³
HS-21	0.25	27.0	3.0		-		5.0		_	* : <u> </u>	1.0	bal	34 <u>8 -</u> 320	(193 <u>年</u> 7.
(MOD Vitallium)				l	ļ	1		İ		1000				a mark man.
HS-31 (X-40)	0.50	25.0	10.0	7.5	l —	_	l —		l —	0.17	1.5	bal	0.4 Si	·
HS-25 (L-605)	0.10	20.0	10.0	15.0		_	l —	l —			_	bal	J	الراؤهية ال
ML-1700	0.2	25.0	—	15.0		l —			0.4	l		bal	1 _	
WI-52	0.42	21.0	1.0 max	11.0		2.0		l —		ļ —	2.0	bal	l	8.88
MAR-M 302	0.85	21.5	·	10.0	9.0			0.2	0.005	_	1.5 max	bal		9.21
MAR-M 322	1.0	21.5		9.0	4.5	_	. —	0.75	_	2.25	0.75	bal	l	8.91
MAR-M 509	0.60	24.0	10.0	7.0	7.5	-	l —	0.2			1.0	bal		8.85
AiResist 13	0.45	21.0	_	11.0	 —	2.0		-		l —	2.5 max	bal	3.4 A1,	8.43
					•					}	,		0.1 Y	
AiResist 215	0.35	19.0	0.5	4.5	7.5	_	_			0.13		bal	4.3 A1,	8.47
			1.			.:.						•	0.1 Y	77.77
F 75	0.25	28.0	1.0 max	_	: -	<u> </u>	5.5		-			bal	_	-
FSX-414	0.25	29.5	10.5	7.0	—			_	0.012	_	2.0 max	bal		8.3
X-45	0.25	25.5	10.5	7.0	L <i>-</i>				0.010		2.0 max			1

Nominal compositions of wrought cobalt-base superalloys

						Con	npositio	n, %		4 F				
Alloy	Ni	Cr	Co	Mo	W	Ta	Nb	Al	Fe	Mn	Si	С	Zŕ	Other
AirResist 213	. —	19	66	-	4.7	6.5	_	3.5		-		0.18		0.1 Y
Elgiloy	15	20	40	7	 	-	l —	 	bal	2	_	0.1		0.04 Be
Haynes 188	22.0	22.0	39.2	_	14.0	l —		1 —	3.0		l	0.10		
L-605	10.0	20.0	52.9	_	15.0	l —	_	. —	-	l — .	i:	0.05		
MAR-M 918	20.0	20.0	52.5	_	 	7.5		l —		l	i	0.05	0.10	
MIP35N	35.0	20.0	35.0	10.0	<u> </u>	_		l _			l	0.00	0.10	
MP159	25.5	19.0	35.7	7.0	_		0.6	0.2	9.0	T	l	_		3.0 Ti
Stellite 6B	3.0	30	bal	1.5	4.5	l — ·		_	3.0	2.0	2.0	1.1		3.0 11
Haynes 150	-	28	50.5	_	<u> </u>]	i —	_	bal		0.75		_ :	0.02 P.
		·	1			l								0.002 S
S-816	20.0	20.0	bal	4.0	4.0	l —	4.0		3.0	1.20		0.40	ŀ ·	0.0020
V-36	20.0	25.0	bal	4.0	_	_	2.3		2.4	1.0		0.32		

Nominal compositions of wrought iron-base superalloys

	T						<u> </u>							Programme Company
٠.					1.44	Co	mpositi	oπ, %		٠				400
Alloy	Ni	Cr	Co	Mo	W.	Nb	Al	Ti	Fe	Mn	Si	С	В	Other
A-286	26.0	15.0	_	1.3			0.2	2.0	54.0	1.3	0.5	0.05	0.015	4 27 4 4 2 3 7 7
Discaloy	26.0	13.5	 	2.7	<u> </u>		0.1	1.7	54.0	0.9	0.8	0.04	0.015	
Alloy 901	42.5	12.5	.··· <u> </u>	5.7			0.2	2.8	36.0	0.1	0.1	0.05	0.015	13.4. II.3.4.
Haynes 556	20.0	22.0	20.0	3.0	2.5	0.1	0.3		29.0	1.5	0.4	0.10		02 N 002
		'		l				1				5,125		La 09Ta
Incoloy 800	32.5	21.0	[. -	_			0.4	0.4	46	-:0.8	0.5	0.05	z : — . "	
Incoloy 801	32.0	20.5	<u> </u>	— ·	<u> </u>	· —		1.1	44.5		0.5	0.05		
Incoloy 802	32.5	21.5		_		_		i	46	0.8	0.4	0.04	<u> </u>	
Incoloy 807	40.0	20.5	8.0	0.1	5.0	<u> </u>	0.2	0.3	25	0.50	0.40	0.05	· .—	10 70 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Incoloy 825	38-46	19.5-	<u> </u>	2.5-	: 	·	0.2	0.6-	22	1.0	0.5	0.05	- 3	1.5-3 Cü.
	:: in	23.5		3.5		200		1.2				. A		0.035
Incoloy 903	38.0	· —	15.0	:		3.0	0.7	1.4	41.0		نوا كوري			
Incoloy 907	~~ 38 ···	· —	13	·		4.7	0.03	1.5 🕆	42		0.15			